

N-Channel 60-V (D-S) MOSFET

PRODUCT SUMMARY				
Part Number	$V_{(BR)DSS}$ Min (V)	$r_{DS(on)}$ Max (Ω)	$V_{GS(th)}$ (V)	I_D (A)
2N7000	60	5 @ V_{GS} = 10 V	0.8 to 3	0.2
2N7002		7.5 @ V_{GS} = 10 V	1 to 2.5	0.115
VQ1000J		5.5 @ V_{GS} = 10 V	0.8 to 2.5	0.225
VQ1000P		5.5 @ V_{GS} = 10 V	0.8 to 2.5	0.225
BS170		5 @ V_{GS} = 10 V	0.8 to 3	0.5

FEATURES

- Low On-Resistance: 2.5 Ω
- Low Threshold: 2.1 V
- Low Input Capacitance: 22 pF
- Fast Switching Speed: 7 ns
- Low Input and Output Leakage

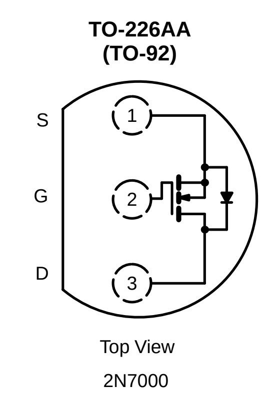
BENEFITS

- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

APPLICATIONS

- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays

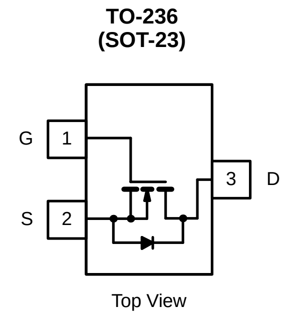
TO-226AA (TO-92)



Top View

2N7000

TO-236 (SOT-23)

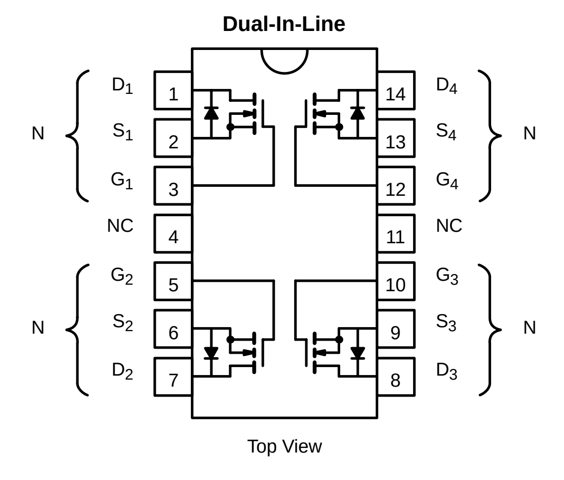


Top View

Marking Code: 72*wll*

72 = Part Number Code for 2N7002
w = Week Code
ll = Lot Traceability

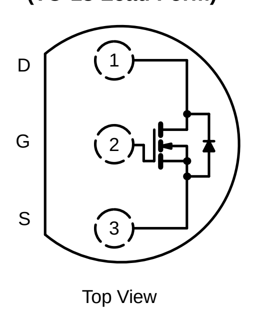
Dual-In-Line



Top View

Plastic: VQ1000J
Sidebraze: VQ1000P

TO-92-18RM (TO-18 Lead Form)



Top View

BS170



ABSOLUTE MAXIMUM RATINGS (T_A = 25°C UNLESS OTHERWISE NOTED)

Parameter		Symbol	2N7000	2N7002	Single VQ1000J	Single VQ1000P	Total Quad VQ1000J/P	BS170	Unit
Drain-Source Voltage		V_{DS}	60	60	60	60		60	V
Gate-Source Voltage—Non-Repetitive		V_{GSM}	±40	±40	±30			±25	V
Gate-Source Voltage—Continuous		V_{GS}	±20	±20	±20	±20		±20	V
Continuous Drain Current (T_J = 150°C)	T_A= 25°C	I_D	0.2	0.115	0.225	0.225		0.5	A
	T_A= 100°C		0.13	0.073	0.14	0.14		0.175	A
Pulsed Drain Current[a]		I_{DM}	0.5	0.8	1	1			A
Power Dissipation	T_A= 25°C	P_D	0.4	0.2	1.3	1.3	2	0.83	W
	T_A= 100°C		0.16	0.08	0.52	0.52	0.8		W
Thermal Resistance, Junction-to-Ambient		R_{thJA}	312.5	625	96	96	62.5	156	°C/W
Operating Junction and Storage Temperature Range		T_J, T_{stg}	–55 to 150						°C

Notes
a. Pulse width limited by maximum junction temperature.
b. $t_p \leq 50\ \mu s$.

SPECIFICATIONS—2N7000 AND 2N7002 (T_A = 25°C UNLESS OTHERWISE NOTED)

Parameter	Symbol	Test Conditions	Typ[a]	Limits 2N7000 Min	Limits 2N7000 Max	Limits 2N7002 Min	Limits 2N7002 Max	Unit
Static								
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 10 μA	70	60		60		V
Gate-Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 1 mA	2.1	0.8	3			V
		V_{DS} = V_{GS}, I_D = 0.25 mA	2.0			1	2.5	V
Gate-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±15 V			±10			nA
		V_{DS} = 0 V, V_{GS} = ±20 V					±100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 48 V, V_{GS} = 0 V			1			μA
		T_C = 125°C			1000			μA
		V_{DS} = 60 V, V_{GS} = 0 V					1	μA
		T_C = 125°C					500	μA
On-State Drain Current[b]	$I_{D(on)}$	V_{DS} = 10 V, V_{GS} = 4.5 V	0.35	0.075				A
		V_{DS} = 7.5 V, V_{GS} = 10 V	1			0.5		A
Drain-Source On-Resistance[b]	$r_{DS(on)}$	V_{GS} = 4.5 V, I_D = 0.075 A	4.5		5.3			Ω
		V_{GS} = 5 V, I_D = 0.05 A	3.2				7.5	Ω
		T_C = 125°C	5.8				13.5	Ω
		V_{GS} = 10 V, I_D = 0.5 A	2.4		5		7.5	Ω
		T_J = 125°C	4.4		9		13.5	Ω
Forward Transconductance[b]	g_{fs}	V_{DS} = 10 V, I_D = 0.2 A		100		80		mS
Common Source Output Conductance[b]	g_{os}	V_{DS} = 5 V, I_D = 0.05 A	0.5					mS
Dynamic								
Input Capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz	22		60		50	pF
Output Capacitance	C_{oss}		11		25		25	pF
Reverse Transfer Capacitance	C_{rss}		2		5		5	pF

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SPECIFICATIONS—2N7000 AND 2N7002 (T_A = 25°C UNLESS OTHERWISE NOTED)

				Limits				
				2N7000		2N7002		
Parameter	Symbol	Test Conditions	Typ[a]	Min	Max	Min	Max	Unit
Switching[d]								
Turn-On Time	t_{ON}	V_{DD} = 15 V, R_L = 25 Ω $I_D \cong$ 0.5 A, V_{GEN} = 10 V, R_G = 25 Ω	7		10			ns
Turn-Off Time	t_{OFF}		7		10			
Turn-On Time	t_{ON}	V_{DD} = 30 V, R_L = 150 Ω $I_D \cong$ 0.2 A, V_{GEN} = 10 V, R_G = 25 Ω	7				20	
Turn-Off Time	t_{OFF}		11				20	

SPECIFICATIONS—VQ1000J/P AND BS170 (T_A = 25°C UNLESS OTHERWISE NOTED)

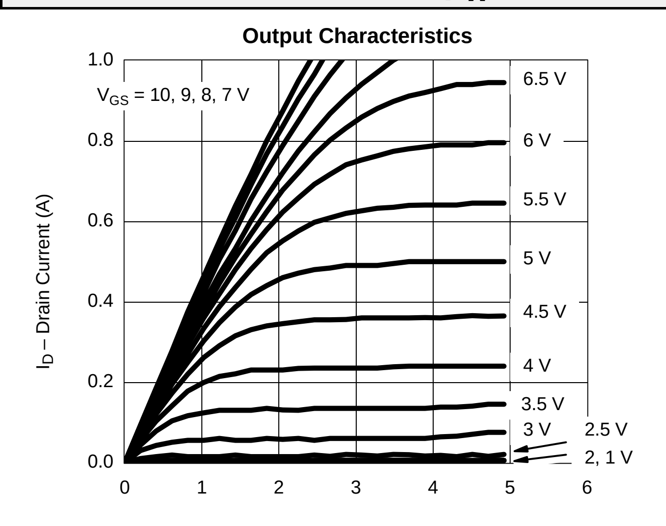
				Limits				
				VQ1000J/P		BS170		
Parameter	Symbol	Test Conditions	Typ[a]	Min	Max	Min	Max	Unit
Static								
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 100 μA	70	60		60		V
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, I_D = 1 mA	2.1	0.8	2.5	0.8	3	
Gate-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±10 V			±100			nA
		T_J = 125°C			±500			
		V_{DS} = 0 V, V_{GS} = ±15 V					±10	
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 25 V, V_{GS} = 0 V					0.5	μA
		V_{DS} = 48 V, V_{GS} = 0 V, T_J = 125°C			500			
		V_{DS} = 60 V, V_{GS} = 0 V			10			
On-State Drain Current[b]	$I_{D(on)}$	V_{DS} = 10 V, V_{GS} = 10 V	1	0.5				A
Drain-Source On-Resistance[b]	$r_{DS(on)}$	V_{GS} = 5 V, I_D = 0.2 A	4		7.5			Ω
		V_{GS} = 10 V, I_D = 0.2 A	2.3				5	
		V_{GS} = 10 V, I_D = 0.3 A	2.3		5.5			
		T_J = 125°C	4.2		7.6			
Forward Transconductance[b]	g_{fs}	V_{DS} = 10 V, I_D = 0.2 A				100		mS
		V_{DS} = 10 V, I_D = 0.5 A		100				
Common Source Output Conductance[b]	g_{os}	V_{DS} =5 V, I_D = 0.05 A	0.5					
Dynamic								
Input Capacitance	C_{iss}	V_{DS} =25 V, V_{GS} = 0 V f = 1 MHz	22		60		60	pF
Output Capacitance	C_{oss}		11		25			
Reverse Transfer Capacitance	C_{rss}		2		5			
Switching[d]								
Turn-On Time	t_{ON}	V_{DD} = 15 V, R_L = 23 Ω $I_D \cong$ 0.6 A, V_{GEN} = 10 V, R_G = 25 Ω	7		10			ns
Turn-Off Time	t_{OFF}		7		10			
Turn-On Time	t_{ON}	V_{DD} = 25 V, R_L = 125 Ω $I_D \cong$ 0.2 A, V_{GEN} = 10 V, R_G = 25 Ω	7				10	
Turn-Off Time	t_{OFF}		7				10	

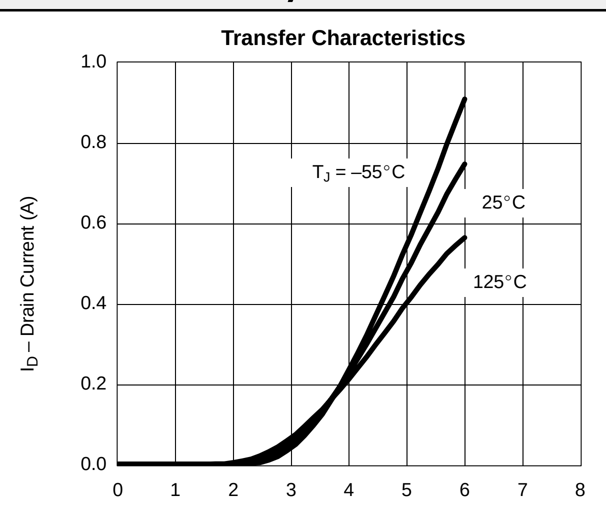
Notes
a. For DESIGN AID ONLY, not subject to production testing.
b. Pulse test: PW ≤80 μs duty cycle ≤1%.
c. This parameter not registered with JEDEC.
d. Switching time is essentially independent of operating temperature.

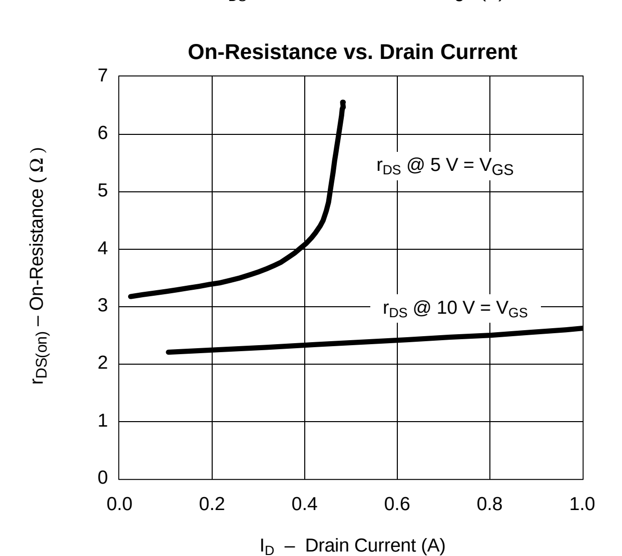
VNBF06

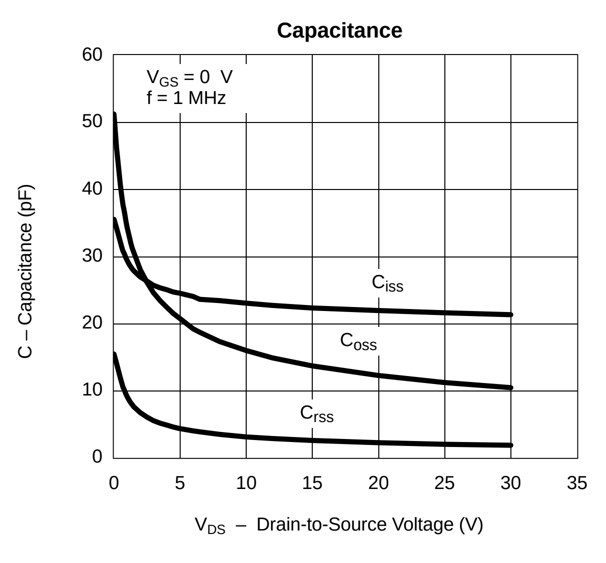


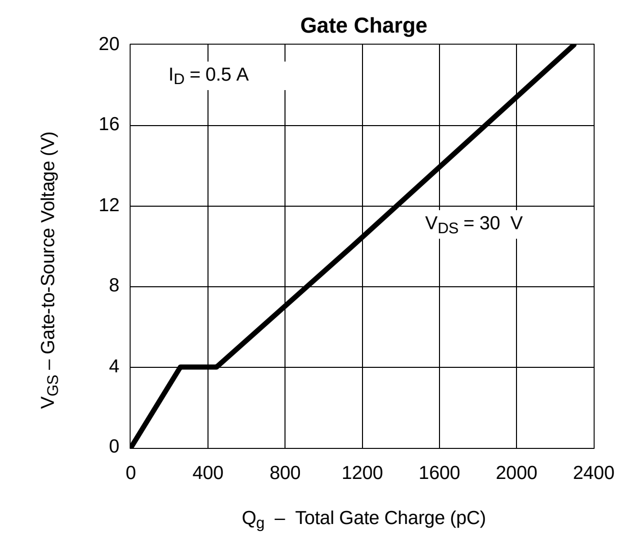
TYPICAL CHARACTERISTICS (T_A = 25°C UNLESS OTHERWISE NOTED)

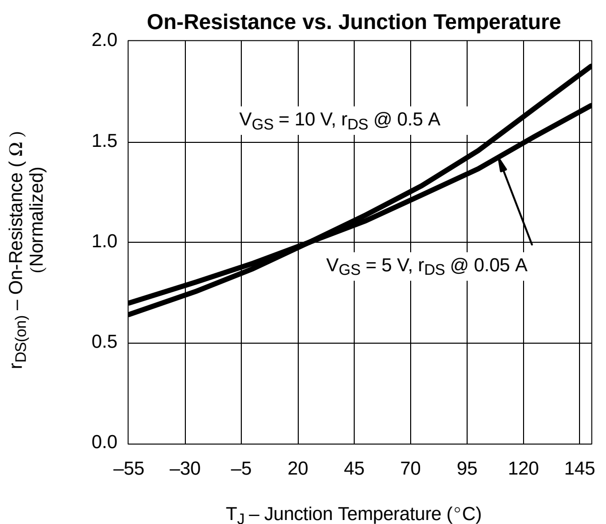




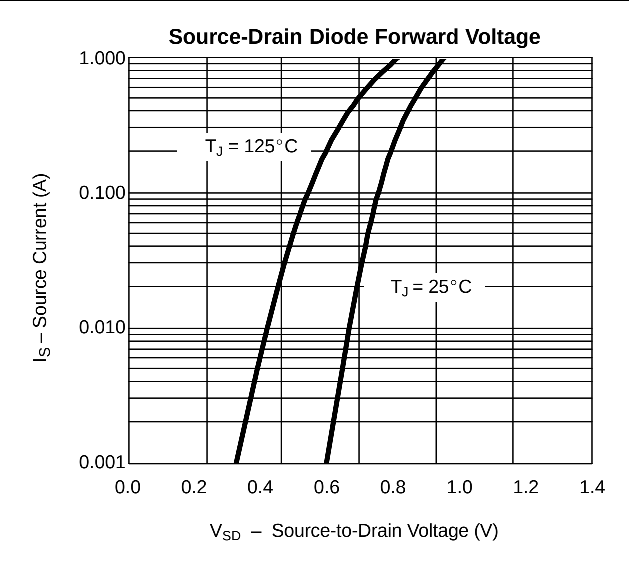


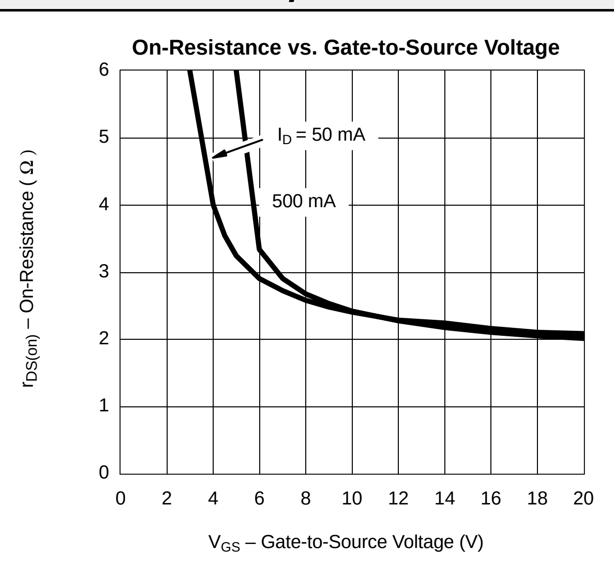


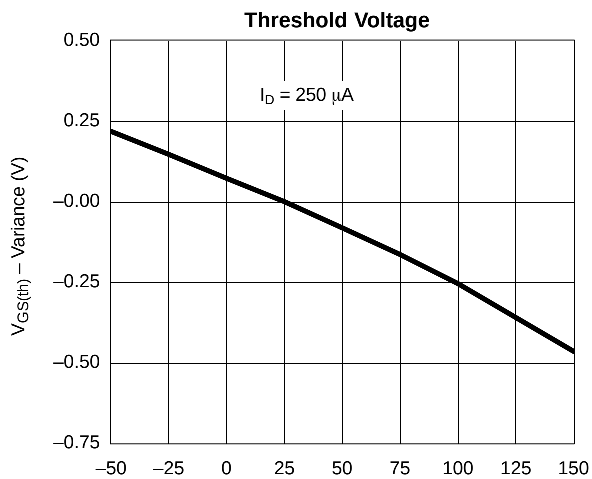


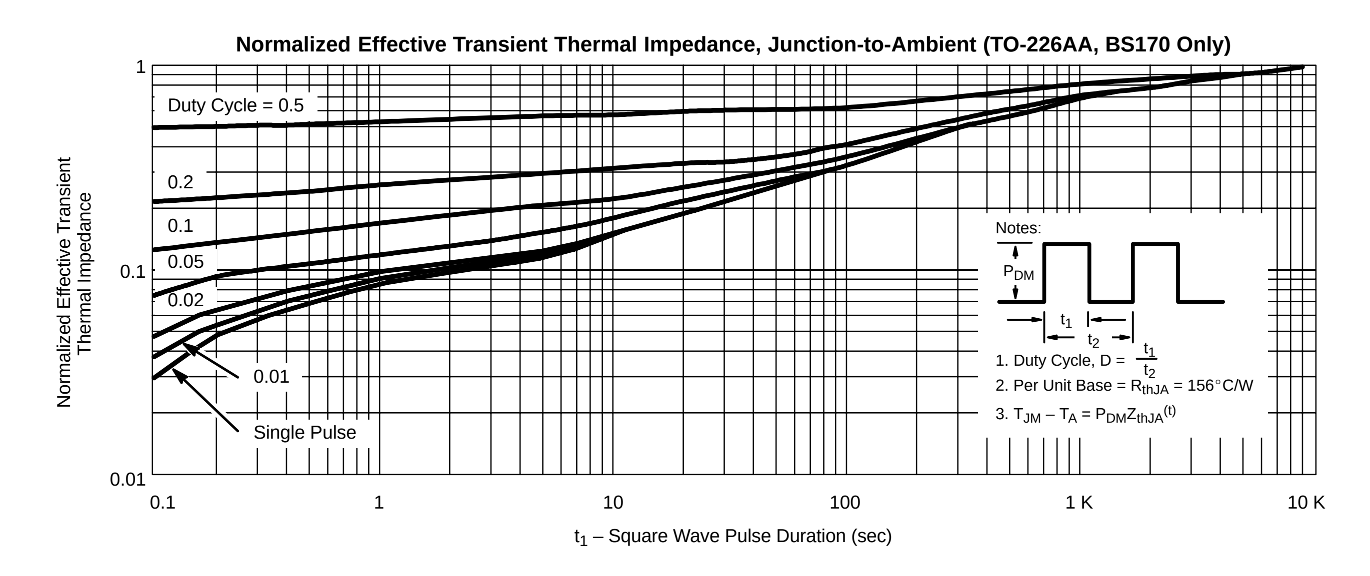


TYPICAL CHARACTERISTICS (T_A = 25°C UNLESS OTHERWISE NOTED)











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